matics Dr. Allman points to such works as Bretschneider's "Die Geometrie und die Geometer von Euklides"; Hankel's "Zur Geschichte der Mathematik in Alterthum und Mittel-Alter" (we are glad to find that our author's opinion of this work harmonises with the judgment we ventured to pass upon it in these columns); to Hoefer's "Histoire des Mathématiques" (1874), and to some others with which we are not acquainted. Dr. Allman opens his remarks with stating that "in studying the development of Greek science, two periods must be carefully distinguished. The founders of Greek philosophy—Thales and Pythagoras—were also the founders of Greek science, and from the time of Thales to that of Euclid and the foundation of the museum of Alexandria, the development of science was, for the most part, the work of the Greek *philosophers*. With the foundation of the school of Alexandria, a second period commences; and henceforth, until the end of the scientific evolution of Greece, the cultivation of science was separated from that of philosophy, and pursued for its own sake." In the course of forty-seven pages the investigation of what discoveries and advances are due to each geometer is most carefully and discriminatingly done, and the reader is put in full possession of the several authorities, and is thus in a position to try the correctness of Dr. Allman's deductions. We shall look forward to the continuation of the present paper which the writer promises.

At a recent meeeing of the Birmingham Microscopical and Natural History Society, Mr. A. W. Wills exhibited the curious rotifer *Melicerta pilula* (figured by Mr. Charles Cubitt in the *Monthly Microscopical Journal* of July, 1872), which coats its tube with a wall of pellets consisting of *its own excremental pilules*. Mr. Wills gave an interesting description of the rotifer, and of his experiments with it. One of the specimens he exhibited had commenced the wall of its tube with the natural pellets, and had finished it first with blue pellets, and lastly with scarlet, according as he had fed it with indigo and carmine. After the meeting Mr. Wills gave the remainder of his specimens to Mr. Bolton for distribution among his correspondents.

It is stated on the authority of a native Japanese paper, that the Hakubutsu Kioku (Exposition Bureau) of the Home Department proposes to erect a permanent exhibition building at Uyano, on the site of the National Exhibition held last year. It will cover about 700 tsuba of ground, and the frontage is to be 360 feet by 75 feet. On its completion it is intended to close the exhibition at Yamashita.

Dr. Manzoni, of Bologna, has recently established the identity of the marl deposits of Upper Austria with those of the Renodale near Bologna, and describes eight varieties of echinoderms common to the two formations. Of these one still exists, and another is likewise found in chalk deposits.

The philosophical faculty of Göttingen has offered two prizes of 1,700 and 680 marks for the best works on the causes affecting the changes in chemical composition of plants of the same species, such as climate, soil, fertilisation, &c. They must include a critical review of all facts hitherto gathered on this subject, and suggestions as to the best methods for completing our knowledge in this department, accompanied by the results of independent research in the directions indicated. Competitors must forward their work before August 31, 1880, and the decision will be announced March 11, 1881. They can make use of Latin, German, French, or English.

W. Lange has sought to answer the question whether the silicium present in the sap of plants is in the form of silico-organic compounds, or not, and finds (*Ber. d. deutsch. chem. Gesell.*, vol. ii.) that it exists exclusively as a hydrate of silicic acid in very dilute solution.

FURTHER RESEARCHES ON THE SCINTILLATION OF STARS

The results at which M. Ch. Montigny had arrived with regard to the influence of the atmosphere upon the scintillation of stars (see Nature, vol. xiv. p. 562) have since been thoroughly confirmed by his further researches on this subject. The series of observations now comprises no less than 447 evenings, and the predominant influence of rain upon the intensity of scintillation may now be recognised as proved beyond doubt. We may here remind our readers that the intensity of scintillation is measured by the number of changes of colour which the star shows in the scintillometer during one second, and that M. Montigny has first proved that approaching moist weather increases this intensity. The frequent occurrence of wet days in the year from August, 1876, to August, 1877, has increased the average intensity from 71 to 76; but the following very dry autumn of 1877 brought down the average to 68 for that season.

M. Montigny has also given continual attention to the relation between the scintillation and the nature of the spectrum of any particular star. He has, as before, classified the 41 stars observed according to the three types of Father Secchi (of which type I. comprises the stars with four lines in the spectrum, type II. those with a number of fine lines or indistinct bands, and type III. those with broad bands and black lines), and for each type the new average intensity of scintillation is now given; each star in these comparative researches being reduced to an altitude of 60°. It appears now that the average for the first type has remained exactly the same as found before, while those for the other two types have changed but very little, although the number of observations has now risen from 611 to 3,025. These slight changes arise, doubtless, from the circumstance that the recent observations extend to 108 stars instead of 41. All these observations confirm, in the most definite manner, that fact which has already resulted from the first observations, and which M. Montigny expresses as follows:—"The stars possessing spectra with dark bands and black lines scintillate less than those with fine and numerous spectral lines, and considerably less than those possessing spectra with but a few principal lines."

Reserving the special data regarding the scintillation-intensities and the details of the stellar spectra for a further communication, M. Montigny now publishes a series of results respecting the colours of stars, which are of extreme interest.

The colours which the stars show in the scintillometer change in frequency from one type to another, and even between stars of the same type. For the same star the colours in their particular shades, in their frequency, and in their brightness, are further affected by temperature, the degree of atmospherical moisture, and the altitude of the star above the horizon. On the same evening, and under the most favourable atmospherical conditions, the number of colours and their brightness decrease steadily as the star rises in the east, and at a certain altitude they are no longer seen. In the west the reverse takes place, *i.e.*, the number of colours and their brightness increase the lower the star sinks, down to a certain altitude above the horizon, which changes according to the clearness of the atmosphere. If the star rises or sets, the limit at which the colours cease to be distinct is all the lower, both in the east and in the west, the finer and warmer the weather happens to be at the time. If the star has passed beyond this limit in rising or has not reached it in setting, it shows only a circle of a constant colour in the scintillometer, *i.e.*, of the colour peculiar to the star, and thus this apparatus offers an excellent means for determining the colours of stars.

The colours observed in scintillation are: red, orange, yellow, green, bluish green, blue, and violet. The difference in these colours is characteristic for the different star types, if we neglect the influence of the star's altitude and the condition of the atmosphere. Thus the red, which is the most constant colour for the three types, generally approaches the shade between the lines B and C of the solar spectrum in stars of the two first types, while stars of the third type give either a very dark red, or a bright cherry red, or very deep pink. The blue in stars of the first type is bright, and resembles steel blue in shade, while the blue in stars of the third type often shows a very dark shade, so dark sometimes that it becomes difficult to recognise it. When the weather was rainy the blue seemed generally to predominate amongst the other colours in all stars. Pure green was not so frequent than the other colours. Violet was also very rare amongst all the stars, but particularly amongst

those of type III.; if this colour was visible in stars of the other two types, they were always near the horizon. Yellow was rarely absent; yellow of greater or lesser brightness predominated completely in a large number of stars when they were high above the horizon and had ceased to scintillate. Orange is very frequent amongst the colours of the stars of the third type, while they scintillate.

If we reflect upon this short sketch of the changes of colour of scintillating stars, we see at once how complicated this phenomenon is, and that, in order to obtain data of tolerable certainty, at least two series of observations must be made, one in dry and the other in rainy weather; and further, that the influence of the star's altitude must be determined, which can be done by dividing the observations into separate zones of five degrees each.

With regard to the colours of scintillating stars Arago has expressed the opinion that the colour observed at any special moment is the complementary colour to those rays of the light peculiar to the scintillating star which at that moment are absent in the eye or in the telescope. M. Montigny agrees with this view and confirms it by an observation which he made when, on some evening specially favourable for observation, he inserted a prism just when the circle produced in the scintillometer by the light of the star Capella was very sharp and showed bright colours; he then found the two arcs of the circle divided into different colours, and this could not have been the case if the colours seen without the prism had actually been present. M. Montigny, however, intends further to examine this question by means of the spectroscope.

Arago also raised the well-known question whether the scintillation of stars is the same for two observers stationed at different places. M. Montigny replies to this question in the negative, and this was Arago's opinion also; he found the colours of a star to be different for those rays which are differently refracted by the two halves of the object-glass. In the same sense M. Donders has noticed that the scintillation does not always show the same peculiarities for each eye of the same observer. Another circumstance may be cited here as another proof, viz., that a double star, both components of which are of the same colour, such as Castor and its companion, which are both white, does not always show the same colours in the scintillometer at the same angles of position. Although the angle separating these two stars amounts to but five seconds of arc, it yet suffices to produce different colours. This shows how greatly the appearance of stars in the scintillometer is affected by the smallest differences in the conditions under which they are observed, since two separate pencils of rays of the same colour travelling side by side and at the same moment may yet be changed to different colours on their passage through the atmosphere.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

The subject of the use and abuse of examinations is beginning to be agitated in Austria. Within a few weeks past, two students, one at Pest and the second at Graz, have committed suicide after failing to pass examinations for the doctor's degree. The latter of the two had completed a lengthy course of study, and was an assistant of recognised ability in the university.

During the past few years the educational institutions of Rome have been entirely reorganised. The university, as constituted at present, is without a theological faculty. It numbers sixty-four professors, twelve in the legal faculty, twenty-four in the medical, sixteen in the scientific, and twelve in the philological-philosophical. Nearly all the conveniences of a well-appointed university are now enjoyed by the students: a botanical garden, laboratories for physics, chemistry, and physiology; the new observatory on the Capitoline, with special institutes for geology, mineralogy, mathematical physics, pharmacy, comparative zoology and anatomy, pathological anatomy, and six clinics. During the past month the Minister of Education has issued a decree for the foundation of a school of archæology, which shall be amply equipped, and meet a want long felt in this centre of archæological investigation.

SOCIETIES AND ACADEMIES

London

Royal Society, May 23.—"Experimental Results relating to the Rhythmical and Excitatory Motions of the Ventricle of the Heart of the Frog, and of the Electrical Phenomena which accompany them," by J. Burdon Sanderson, M.D., F.R.S., and F. J. M. Page, B.Sc., F.C.S.

This paper, although of some length, is a condensed statement of experimental results, so that it scarcely admits of being abstracted. These relate, as stated in the first paragraph, to (1) the order and duration of the rhythmical and excitatory motions of the heart of the frog, (2) the normal electrical condition of the surface of the heart and the influence thereon of mechanical, chemical and thermal injuries, and (3) the characters of the normal and of the excitatory electrical variations, and the modifications of those characters which are induced by injuries of the surface, and under the temporary influence of radiant heat. As we have not space to reproduce the whole, we will confine ourselves chiefly to the very interesting experiments contained in the two last sections.

The authors begin this part of the subject with the statement that they have confirmed, by repeated experiment, the observations made by Engelmann in 1873, that all parts of the surface of the "resting" heart are equipotential, and that the electrical inequalities which are usually found whenever the surface of the organ is investigated, when in this condition, owe their existence to slight injuries; they then proceed to discuss the conditions which lead to the existence of electrical differences. These are (1) permanent injury of the surface, however superficial and slight in extent, and (2) the temporary influence of radiant heat. As regards permanent injury, their observations are substantially in accordance with the conclusions of Hermann as regards other excitable and contractile tissues, viz., that the death of a part renders it *negative* to all living parts of the same organ. Substituting for the word death (which, in order to express the whole truth, must be understood to include every degree of local lesion, however limited in extent or slight in degree) the expression "permanent injury," this proposition becomes adequate for its purpose.

The authors further find that the influence of radiant heat produces a modification of the electrical condition of a part, of which the sign is opposed to that of the electrical change produced by injury. They were led to this result by the consideration that if arrest of the chemical changes which constitute the life of a part renders it negative, it is probable that a momentary intensification of these changes will render it positive.

The fundamental experiment by which both facts are established is as follows:—Two points on the surface of the heart, which may be as near to each other as two millims., are connected with a galvanoscopic circuit, and found to be equipotential. A loop of platinum wire, heated by a current, is brought into the neighbourhood of one of them for one second. After an interval of about a second the warmed surface becomes positive: in a few moments this effect subsides. If, then, the hot wire is brought nearer so as to scorch the surface, however slightly, and then removed, the opposite effect—that of permanent injury—manifests itself. The same spot, which was before positive, now becomes negative in a very much greater degree; for whereas the temporary "positivity" scarcely exceeds 1-2,000th Daniell, the "difference" of potential produced by injury may amount to 3-100ths Daniell. On the physiological meaning of these effects the authors do not enter. An indication of their bearing is, however, given by the observation in the next section, which relates to the so-called variation of the heart. By variation is meant the electrical disturbance which accompanies, or rather precedes, each contraction of the ventricle. The fact that such a disturbance exists has been known for several years. It has also been recognised that it precedes the visible change of form by which the systole discloses itself. The authors now show that the disturbance consists of two phases having opposite signs—that in the first phase, which is of short duration, parts near the apex become positive to parts further from it; that in the second phase the opposite condition is observed; further, that the first phase is entirely over before the ventricle begins its contraction, whereas the second phase corresponds in duration with the period during which the ventricle is doing the greatest amount of mechanical work, and ceases at the moment of decline of the muscular contraction of the ventricle. These time relations of the two phases suggest the inference that in all probability the first phase corresponds with that of the negative variation of ordinary muscle, with which it agrees in sign, and that the second phase is more immediately associated with the muscular contraction. That this is so appears to be shown by the observation that if any two points of the rhythmically pulsating heart *a* and *b*, of which *a* is nearest to the apex, are investigated by